



The role of eating expectancies and eating motives in the association between mood and loss-of-control eating: A national sample daily diary study

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ABSTRACT

Loss-of-control eating (LOCE, the subjective inability to refrain from eating or cease eating), is highly mood-driven. Mood-related eating motives and eating expectancies have been identified as contributors to binge eating. However, little is known about how these factors relate to LOCE, much less their relationship with daily-level LOCE. This study assessed the impact of trait eating expectancies and daily eating motives on the relationship between daily affective states and LOCE. United States adults ($n = 109$) reporting recent LOCE participated in a ten-day diary study, completing two surveys per day regarding eating behaviors, mood, and motives. Data were analyzed at the within- and between-subject levels utilizing a Bayesian approach to examine pathways from mood to LOCE, mediated by eating motives and accounting for a moderating impact of baseline eating expectancies on the path leg between mood and motives. Negative mood was associated with LOCE at both the within- and between-subjects level by way of coping motives, and directly at the within-subjects level. Negative affect (NA) reduction expectancies did not moderate the indirect pathway. Positive mood was only associated with LOCE at the within-subjects level, via pleasure motives. This relationship was potentiated via reward expectancies. Therefore, although negative mood appears to be a robust predictor of LOCE regardless of trait NA reduction expectancies, positive mood appears to have a specific set of conditions under which individuals are at increased likelihood of LOCE at the within-subjects level. These findings suggest that eating expectancies and motives for eating may be meaningful targets in LOCE interventions.

1. Introduction

Binge eating (i.e., the subjective sense of losing control over one's eating and consuming an objectively large amount of food), is a core diagnostic feature of eating disorders such as binge-eating disorder and bulimia nervosa (American Psychiatric Association, 2013). Importantly, accruing research indicates that the sense of losing control over one's eating (frequently termed loss-of-control eating or LOCE) is a deleterious phenomenon regardless of presence of objective overeating, eating an amount most would consider large in circumstances that are unusual to consume that quantity of food (Brownstone, 2017; Latner et al., 2007). For example, individuals who engage in LOCE without objective overeating report similar levels of eating disorder pathology, anxiety, and depression to those who primarily report binge-eating episodes (Latner

et al., 2007). LOCE without clinically significant overeating has also been associated with areas of impairment related to binge eating including poorer quality of life (Jenkins et al., 2012), functional impairment (Mond et al., 2006), and obesity (Palavras et al., 2013). The adverse consequences associated with LOCE are particularly alarming in light of its high prevalence, with approximately 45% of non-clinical samples, such as college-age women (Vannucci et al., 2013) or an online sample of United States (U.S.) adults (Brownstone, 2017) reporting at least one LOCE (with or without objective overeating) within a three-month period. Understanding etiological factors that contribute to LOCE is an important area of public health.

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1.1. Positive and negative mood

Mood trajectories are the fluctuation in mood or affect over time, typically measured at multiple time points in one day via (EMA). In studies using ecological momentary assessment (EMA) to measure momentary moods and eating behaviors multiple times across the course of a day, mood states – particularly negative mood states – have been shown to predict subsequent LOCE, both with and without overeating (Berg et al., 2017; Haedt-Matt & Keel, 2011a; Stevenson et al., 2018). In particular, evidence indicates that negative affect increases in the hours before LOCE episodes with and without overeating (Goldschmidt et al., 2012). However, the link between positive mood and LOCE is less definitive. Some studies have shown no change in positive mood prior to eating episodes characterized by higher levels of LOCE (Felonis et al., 2021; Stevenson et al., 2018). Further, some studies have found no relationship between positive mood and LOCE with overeating (Wolff et al., 2000), although others provide evidence for a positive relationship between positive mood and LOCE with and without overeating (Egbert et al., 2020). It is possible that one reason for these inconsistencies is failure to account for salient influencing factors. Two such factors may be expectations about the effects that eating will have on mood, and affectively driven eating motivation.

1.2. Eating expectancies

Two particular eating expectancies have been implicated in LOCE: expectations that eating reduces negative affect (NA reduction expectancies; Boerner et al., 2004; Fischer & Smith, 2008; Hayaki & Free, 2016; Hohlstein et al., 1998; Schaumberg et al., 2016; Smith et al., 2007) and expectations that eating is pleasurable and useful as a reward (reward expectancies; Bohon et al., 2009). NA reduction expectancies have been directly linked to LOCE cross-sectionally regardless of quantity of food consumed and have been shown to interact with other psychological vulnerabilities (e.g., distress tolerance, emotion regulation difficulties) to predict LOCE (Burr, 2021). Given that negative mood typically increases prior to LOCE with and without overeating, and then decreases following the eating episode (Kukk & Akkermann, 2017; Schaefer et al., 2020; Stevenson et al., 2018), it is theoretically consistent that NA reduction expectancies would be greater in individuals who have greater LOCE frequency. In contrast, the relationship between reward expectancies and LOCE has been less consistent in the literature. For example, in some studies reward expectancies have been found to be inversely related to LOCE with overeating (De Young et al., 2014), or to have nonsignificant associations with, binge eating broadly (Hayaki & Free, 2016; Hohlstein et al., 1998) and LOCE in particular (Burr, 2021). Therefore, it is important to clarify the influence of implicated expectancies influence on LOCE risk, including the possible interactions with other LOCE risk factors (i.e., mood, motives).

1.3. Eating motives

Eating motives have been linked to binge eating (Boggiano, Wenger, Turan, Tatum, Sylvester, et al., 2015), although motives regarding LOCE independently have been underrepresented in the literature to-date. Prior research has identified a connection between mood-related motives (e.g., coping motives, reward motives) and more frequent binge-eating episodes (Boggiano et al., 2014, 2015; Fazzino et al., 2018), as well as greater binge eating severity (Boggiano, Wenger, Turan, Tatum, Sylvester, et al., 2015; Burgess et al., 2014). Coping motives are negatively reinforced internal factors, such as a desire to decrease negative mood (Cooper, 1994). Other vulnerabilities related to LOCE have also been associated with greater coping motives, such as habitual consumption of highly palatable foods (Mantzios et al., 2019; Pompili & Laghi, 2019), eating independent of hunger (Boggiano, Wenger, Turan, Tatum, Sylvester, et al., 2015), greater body mass index (BMI; Burgess et al., 2014; Mantzios et al., 2019), and more weight gain over time

(Boggiano, Wenger, Turan, Tatum, Sylvester, et al., 2015). Coping motives are also directly related to greater stress (Boggiano et al., 2015b, 2017) and overall negative mood (Jackson et al., 2003; Trojanowski et al., 2019). Given that heightened negative mood robustly precedes LOCE (Leehr et al., 2015; Pearson et al., 2018; Stevenson et al., 2018), it follows logically that momentary motivation to cope or reduce negative affective states may serve as a mechanism leading to LOCE.

In addition to coping motives, pleasure motives have been linked to LOCE with overeating (Boggiano et al., 2014; Fazzino et al., 2018), as well as related vulnerabilities such as eating triggered by negative mood (Jackson et al., 2003) and higher BMI (Boggiano, Wenger, Turan, Tatum, Sylvester, et al., 2015; Mantzios et al., 2019). However, there is less consensus linking pleasure motives to LOCE than there is for coping motives (Boggiano et al., 2017; Burgess et al., 2014). Pleasure motives are positively reinforced, internally driven factors (Cooper, 1994), such as eating for a sense of reward and enjoyment (Cooper, 1994; Ferriter & Ray, 2011). Unlike coping motives, there is no readily apparent preliminary link regarding a potential role of pleasure motives between mood and LOCE, although individuals may seek out opportunities for reward or celebration through consumption of highly palatable foods (Burgess et al., 2014), which are the same types of foods that individuals are more likely to consume in an uncontrolled manner. However, this link has been found for other deleterious behaviors (e.g., substance use, see Stevenson et al., 2019). Given how strongly mood, and particularly negative mood is predictive of LOCE and coping motives, it is arguably necessary to investigate whether affective states can be linked to pleasure motives, and to identify other factors that may influence such a relationship.

1.4. Integration of motives and expectancies

Conceptually, motives and expectancies are very similar constructs, as other researchers have pointed out (Ham & Hope, 2003). However, they are also differentiable in many notable ways. Tolman (1932) conceptualized an expectancy as a learned causal relationship between behavior and outcome. Research regarding eating expectancies to-date has also conceptualized them as enduring mental structures based on prior learning stored in a network memory model (Gokey-LaRose, 2006). In contrast, motives may be more temporal factors, subject to change based on contextual elements (e.g., current affective state). Longitudinal research has shown that endorsement of specific eating motives may change over time (Boggiano, Wenger, Turan, Tatum, Sylvester, et al., 2015) and EMA findings suggest different affectively driven motives may be endorsed at different timepoints both in the eating pathology literature (Boggiano et al., 2015b) as well as related literature examining other maladaptive behaviors, such as alcohol use (Cook et al., 2020; Stevenson et al., 2019). This suggests a trans-theoretical model of affectively driven motivation in which motives may be more state-like, fluctuating from moment to moment and driven by factors, such as momentary mood, that propel one to act in real time, while expectancies may represent a more stable mental construct, influencing the link between mood and this motivational drive.

Thus, conceptually, expectancies represent the learning and reinforcement history of a given behavior (Tolman, 1932) while motives represent the translation of that learning history from a mental structure to affectively driven behavior (Boggiano et al., 2015b). In essence, while eating motives may explain why an individual chooses to eat at any given moment, eating expectancies may better capture that individual's general heuristics regarding the likely outcomes of food consumption. Expectancies may therefore be more stable factors that contribute to state-level motives in conjunction with present mood, but are less variable in terms of presence, although a particular expectancy may not always be situationally salient given that individuals may have multiple expectancies regarding one behavior (Gokey-LaRose, 2006). Therefore, enduring eating expectancies may theoretically interact with the presence of affect in increasing the likelihood of occurrence of affect-driven

motives, which become increasingly salient by presence of an expected desired outcome. Motives and expectancies have been shown to have an interactive effect in predicting maladaptive behavior, at least, in the context of alcohol consumption (Anderson et al., 2011). However, this effect has not been tested in maladaptive eating.

To our knowledge, there is no prior research that simultaneously examines the roles of expectancies and motives on eating behavior. However, substance use literature, and particularly alcohol use research has not only differentiated expectancies from motives (Kuntsche et al., 2010), but shown that expectancies predict motives, at least at the between-subject level (Bacio, 2021; Madden & Clapp, 2019; Zamboanga et al., 2018). Previous research has shown that models of drug motivation are often applicable to pathological eating (Stojek et al., 2015). The current study is therefore based on the premise that expectancies and motives are separate but related constructs, wherein expectancies are associated with global motivational drive at the between-subject level and influence the link between mood and motives at the within-subject level.

1.5. Study overview

The current study was designed to assess the role of eating expectancies and motives in influencing the relationship between affective states (positive and negative mood) and LOCE in a ten-day diary study among a national online sample of U.S. adults. Due to the mood-driven nature of coping and pleasure motives, motives were conceptualized as a mediator and measured at the daily level as a temporal driver of daily LOCE presence. It was hypothesized that there would be a positive mediating effect between positive mood, pleasure motive, and LOCE at the within-subjects and between-subjects levels. Although prior eating research has shown less consistency in linking positive mood and pleasure motives to LOCE, it is possible that failure to account for other influencing factors that may vary between subjects (e.g., expectancies) could reconcile those findings, as they do in substance use literature (Stevenson et al., 2019). It was also hypothesized that there would be a significant positive pathway from negative mood to coping motive to LOCE at both the within- and between-subjects levels, as prior research has consistently found associations between negative mood and LOCE. Conceptualizing expectancies as more stable beliefs that are not likely to alter across time, NA reduction and reward expectancies assessed at baseline were analyzed as potential moderators of the model path between negative mood and coping motives and positive mood and pleasure motives respectively. It was hypothesized that NA reduction expectancies would potentiate the relationship between negative mood and coping motives at the within-subjects level and that reward expectancies would potentiate the relationship between positive mood and pleasure motives at the within-subjects level.

2. Method

2.1. Participants

Participants were 109 U.S. adults recruited nationally via social media who reported a minimum of two or more LOCE episodes per week over the past two weeks to ensure a sufficient number of LOCE episodes could be captured over the 10-day period.¹ The sample was 24.05% male ($n = 26$) and had an average age of 36.65 (12.70) years. The mean sample BMI (weight (pounds)/[height (inches)]² x 703) was in the overweight range ($M = 28.76$, $SD = 9.56$). Participants reported the state or territory from which they were completing the study, and these were grouped into five categories based on the major U.S. Census regions (U.S. Census Bureau). The breakdown was as follows: 18.35%

from the Northeast ($n = 20$), 36.70% from the South ($n = 40$), 22.02% from the Midwest ($n = 24$), and 21.10% from the West ($n = 23$). Two participants completed the study from the territories of American Samoa (0.01%, $n = 1$), and the Northern Mariana Islands (0.01%, $n = 1$). For more detail on participant characteristics, see Table 1.

2.2. Procedure

This study was comprised of two-phases. Participants were recruited via advertisements through Facebook and Instagram over a 2-month span between August 2020 and October 2020. The study was titled “Mood, Eating, and Related Behaviors During the COVID-19 Epidemic”. This study was approved by the institutional review board at the University of Central Florida, from which it was hosted and conducted within compliance of APA research standards. Participants were informed of the study design and purpose, which was described to them as an assessment of factors that may contribute to eating behavior during the pandemic. Participants were also informed compensation was only provided if they were selected for the second phase and completed both study phases, for which they could earn up to \$25.00. Participants provided informed consent prior to completing each phase of the study. The first phase of the study was an online screener survey that collected baseline data and was completed by 3331 participants. Participants who completed the survey in full and endorsed two or more LOCE episodes per week over the past two weeks were eligible to participate in the second phase of the study. Presence of LOCE to meet eligibility criteria was assessed for with a single item probing frequency of LOCE: “Over the past 2 weeks (14 days), how many times per week did you feel like you had lost control over your eating (unable to keep from eating or stop eating)?”. Participants were invited every ten days to participate until approximately 100 individuals had enrolled in phase two. The final sample was 109 participants enrolled in phase 2, all of whom completed the second phase.

Phase two consisted of a 10-day daily diary design with two surveys per day. Participants completed brief online surveys in the mornings and evenings regarding their eating behaviors, mood, and eating motives.

Table 1
Descriptive statistics.

	Descriptive Statistics			Range
	%	Mean	SD	
Demographic Variables				
Age	–	36.649	12.704	19–66
Sex (female)	75.23	–	–	–
BMI	–	28.760	9.560	17.33–57.77
Race				
White/Caucasian	67.90	–	–	–
Black/African American	12.27	–	–	–
Asian	14.68	–	–	–
American Indian/Alaskan Native	0.73	–	–	–
Native Hawaiian/Pacific Islander	0.92	–	–	–
Other	0.92	–	–	–
Ethnicity (Hispanic)	11.01	–	–	–
Eating Pathology				
EDEQ	–	3.270	0.982	4.62–5.85
LOCES	–	73.101	17.067	27–112
Eating Expectancies				
EI Reward	–	29.500	6.934	11–42
EI NA Reduction	–	81.972	19.720	24–116
Daily Predictors				
Positive Mood	–	2.653	0.904	1–5
Negative Mood	–	2.450	0.771	1–5
Coping Motive	–	2.720	0.943	1–5
Pleasure Motive	–	3.192	0.991	1–5
Daily Outcome				
LOCE	39.05	–	–	–

BMI: Body Mass Index; **EDEQ:** Eating Disorders Examination Questionnaire; **LOCES:** Loss-of-Control Eating Scale; **EI:** Eating Expectancy Inventory; **LOCE:** Percent of Days with Loss-of-Control Eating.

¹ One participant was included in phase two who did not meet minimum LOCE criteria due to coding error.

Surveys were sent via email twice a day through Qualtrics, once at 8:00 a.m. and once at 5:00 p.m. ET. Participants had 2 h to complete each survey. All study materials including survey instruments, data, and analyses are available at <https://osf.io/da79z/>.

2.3. Measures

2.3.1. Baseline measures

2.3.1.1. Demographic variables. Age and biological sex were self-reported by participants. Height and weight were also self-reported and used to calculate BMI using the English System formula provided by the Center for Disease Control and Prevention: $\text{weight (pounds)}/[\text{height (inches)}]^2 \times 703$ (Centers for Disease Control and Prevention, 2014). Baseline LOCE presence was assessed with a single item asking for the number of LOCE episodes each individual had per week over the past two weeks. Baseline LOCE severity was assessed via the Loss-of-Control over Eating Scale (LOCES; Latner et al., 2014), a 24-item self-report assessment of LOCE. Given that these variables may be associated with LOCE based on prior findings, age and sex (Burr et al., 2021), as well as BMI (Tanofsky-Kraff et al., 2008), were all controlled for in the current analyses. LOCES scores are provided for descriptive purposes.

2.3.1.2. General eating pathology. Baseline global scores for the Eating Disorders Examination Questionnaire (EDEQ; Fairburn & Beglin, 2008) were included as a covariate in analyses in order to control for the potential effects of other eating pathology on LOCE, with which it has been associated in prior research (Burr et al., 2021). The EDEQ is a 28-item self-report measure in which items are rated 0–6 scale (“no days”/“not at all” to “every day”/“markedly”), indicating the degree to which an individual experienced an eating-disordered cognition (e.g., “Have you had a definite desire to have a totally flat stomach?”) or behavior (e.g., “Have you been deliberately trying to limit the amount of food you eat in order to influence your shape or weight?”) over the past 28 days. The EDEQ is categorized into four subscales (Restraint, Eating Concern, Shape Concern, and Weight Concern) and the global score is calculated by averaging the means of the subscales’ scores. Scale reliability for the global score was acceptable in this sample ($\alpha = 0.81$).

2.3.1.3. Eating expectancies. Subscales from the Eating Expectancies Inventory (EEI; Hohlstein et al., 1998) were used to assess baseline expectancies of eating outcomes. The EEI in full is a 34-item assessment with five subscales and items rated on a 1–7 Likert scale based on agreement with statements (“completely disagree” to “completely agree”). For these analyses, the subscales Expectancy Eating Helps Manage Negative Affect (EEI-NA) and Expectancy Eating is Pleasurable and Useful as a Reward (EEI-R) were utilized to evaluate NA reduction expectancies and reward expectancies, respectively. The EEI-NA subscale has 18 items probing the expectancy that eating alleviates negative emotions (e.g., “when I am feeling depressed or upset, eating can help me take my mind off my problems”). The EEI-R subscale consists of 6 items that assess the expectancy eating will be pleasurable or rewarding (e.g., “eating is fun and enjoyable”). Previous research supports the reliability and validity of the EEI as a measure of eating expectancies (Boerner et al., 2004; Fischer et al., 2013; Hohlstein et al., 1998). Internal consistency for the EEI-NA ($\alpha = 0.92$) and the EEI-R ($\alpha = 0.80$) were acceptable in these data.

2.3.2. Diary surveys

2.3.2.1. Positive and negative mood. Positive and negative moods were assessed using items from the Positive and Negative Affect Schedule-X (PANAS-X; Watson & Clark, 1994) and Larsen and Diener’s mood circumplex (Larsen & Diener, 1987) in the morning and evening. Moods

were selected to provide a wide coverage of common mood states based on prior research examining mood-LOCE associations at the daily level (see Stevenson et al., 2018). Moods from both morning and evening assessments were combined to form composite daily mood variables. The PANAS has individuals rate their current mood from 1 (“very slightly or not at all”) to 5 (“extremely”) on 12 moods (e.g., “how stressed do you feel?”). Five negative mood domains consisting of 10 items (anger: angry, frustrated; sadness: sad, depressed; anxiety: anxious, nervous; stress: stressed, overwhelmed; and guilt: angry at self, guilty) were combined to form a negative mood indicator. Multi-level composite reliability was examined at the between-subjects and within-subjects levels, as per Geldorf and colleagues (2014). Reliability for the negative mood variable was acceptable ($\alpha_{\text{within}} = 0.92$; $\alpha_{\text{between}} = 0.97$). Two positive mood states (happy, joy) were combined to make one positive mood indicator, with acceptable reliability ($\alpha_{\text{within}} = 0.93$; $\alpha_{\text{between}} = 0.96$).

2.3.2.2. Eating motives. Daily eating motives were assessed in the evenings using adapted items taken from the Motivations to Eat Scale (MES; Jackson et al., 2003). The MES in full is a 20-item assessment that taps common eating motives with four subscales ranking the frequency (1–5; “almost never/never” to “almost always/always”) to which one is motivated to eat due to different rationale. To reduce the demand of daily assessment, a single item representing coping motives and a single item representing pleasure motives were adapted to a daily format from the MES. These items were selected based on prior research indicating high factor loadings for the item within the given construct. Specifically, participants were asked during the evening assessment to rate the frequency of daily motives driving their eating with the items: “Over the course of today, how often did you eat as a way to help you cope?” and “Over the course of today, how often did you eat because you like to eat?”.

2.3.2.3. Loss-of-control eating. LOCE was measured at the daily level using an item taken from the Eating Disorder Examination Questionnaire (EDEQ; Fairburn & Beglin, 2008) tapping LOCE and adapted for daily-level reporting of presence of LOCE. The item “over the course of today ... did you have a sense of having lost control over your eating (at the time that you were eating)?” was used to assess for daily presence of LOCE at the evening assessment. The item response was coded with “yes/no” to account for the presence of an LOCE episode. During the morning surveys administered after the first day, participants were asked this item if they indicated having eaten the previous day after completing that evening’s survey. Indications of LOCE were then counted towards the day prior, if LOCE had not already been reported on the previous day. LOCE days was used as the outcome for this study.

2.4. Data preparation and analysis overview

All data for this study is available on Open Science Foundation through this link: <https://osf.io/da79z/>. The present data was collected twice daily for 10 days among $n = 109$ participants. Eating motives were only collected at night. There were a total of $n = 993$ days of data, however, eating motives were only available for $n = 944$ days due to missing evening assessments (missingness = 4.94%). Further, male sex at birth was associated with a greater likelihood of missed evening assessments ($OR = 0.26$, $p = .042$) indicating these observations were not missing at random. Thus, we used multiple imputation from 20 imputed datasets to calculate the parameters for the eating motives variables.

The data was analyzed using a multilevel structural equation model in Mplus 8.6 (Muthén & Muthén, 2020) that controlled for age, sex, BMI, and EDEQ scores. We used the Bayes estimator which is appropriate for nested data with a dichotomous outcome. Convergence was ensured following recommendations of (Muthén & Asparouhov, 2012). We used non-informative priors for all parameter estimates and an inverse

gamma distribution for random variance estimates. Variance in variables assessed daily was parsed across levels by centering within-person using each individual’s mean, and between-persons using the grand-mean. Thus, at level 1, parameters represent deviations from the individual’s mean, while at level 2, parameters represent deviations from the overall mean. The outcome variable was dichotomous (experienced LOCE that day). At level 1 this is a logistic outcome, while at level 2 this represents a ratio of days with an LOCE.

At level 1, the model examines pathways from daily mood to LOCE, mediated by motives and accounting for a moderating impact of expectancies at level 2. It was hypothesized that NA reduction expectancies would moderate the association between negative mood and coping motives. It was further hypothesized that reward expectancies would moderate the association between positive mood and eating for pleasure motives. Significant cross-level interactions were examined both by calculating simple slopes of motives on mood at high (+1SD) and low (-1SD) expectancies as well as by using the regions of significance to identify where the main effect transitions from non-significant to significant. At level 2, a similar model was specified, with the exception that expectancies are directly associated with eating motivation. For all parameter estimates, notation of “statistically significant” effects indicate the 95% Bayesian Credibility Interval does not include zero. The model controlled for covariates of day of week and number of days in the study at level 1 and age, sex, and BMI at level 2. Below we present standardized coefficients for ease of interpretation and to aid in future replication efforts.

3. Results

3.1. Descriptive statistics

Descriptive statistics are in Table 1. Across both the within-subject and between-subject levels, positive mood was inversely correlated with negative mood. In contrast, coping and pleasure eating motives were positively correlated across both levels of analysis. Negative mood had a week negative correlation with pleasure motives at level 1 and no significant association at level 2. Positive mood was negatively correlated with coping motives at level 1 but positively correlated with both coping and pleasure motives at level 2 (see Table 2). For both mood and motives, variance was split roughly equally at the within- and between-subjects levels (positive mood ICC = 0.64, negative mood ICC = 0.66, coping motive ICC = 0.48, pleasure motive ICC = 0.49), in contrast, the vast majority of the variance in LOCE was at the within-subjects level (ICC = 0.26).

3.2. Bayesian path analyses

A multilevel structural equation model was specified in Mplus 8.6 (L. K. Muthén & Muthén, 2020), controlling for age, sex, BMI, and EDEQ. A pseudo-R² was used to provide model variability estimates for a

Table 2
Intercorrelations between daily variables.

	1.	2.	3.	4.	5.
1. Negative Mood	–	.29**	.15**	.08*	.11**
2. Positive Mood	.26**	–	.11 ^a	.05*	.08*
3. Coping Motive	.46**	.21*	–	.14**	.25**
4. Pleasure Motive	.08*	.21*	.51**	–	.31**
5. LOCE	.13**	–.00	.37**	.25**	–

Within-subjects correlations reported above the dashes, between-subjects correlations reported below the dashes. Correlations with LOCE were calculated by subtracting variance accounted for at each level from total variance then dividing by total variance to get a pseudo-R², then taking the square root of that value.

^a indicates significance at the $p < .05$ level; ** indicates significance at $p < .001$.

categorical outcome at both levels. Likelihood of daily LOCE was the outcome variable. All level 1 paths and intercepts were allowed to vary randomly. At both levels, negative mood predicted coping motives, which in turn predicted LOCE. At level 1, a direct path from negative mood to LOCE was added, as previous research shows direct links from negative mood to LOCE. The same path was tested for negative mood at level 2 and positive mood at both levels. These paths were not supported, and thus removed. A cross-level interaction of NA eating expectancies (level 2) was added as a predictor of the level 1 negative mood to coping motives path. At both levels, positive mood was a predictor of eating for pleasure motives. A cross-level interaction of reward expectancies (level 2) was added as a predictor of the level 1 positive mood to pleasure motives path. Finally, at level 2, both expectancies were regressed onto both mood states and each motive was regressed onto the corresponding expectancy (reward → pleasure motive; NA reduction → coping motive). The initial model converged in 400 iterations (200 burn-in followed by 200 estimation iterations). This model was re-run using 50,000 iterations (25,000 burn-in, 25,000 estimation), to ensure convergence. Potential scale reduction in the final iteration was 1.001 indicating adequate convergence criteria was met. Due to model complexity (i.e., dichotomous outcome with five random slopes and 5 random intercepts), indices of model fit are not available. Table 3 shows within-subject results for the total and conditional indirect paths.

3.2.1. Negative mood to LOCE

At the within-subjects level, the direct pathway of negative mood to LOCE was statistically significant, as was the pathway from negative mood to coping motives. Additionally, the pathway of coping motives to LOCE was statistically significant. Therefore, there was both a significant direct and indirect pathway between negative mood and LOCE at the within-subjects level such that greater negative mood predicted daily LOCE presence, and this relationship was partially mediated by coping motives (see Table 2). The moderating influence of NA reduction expectancies on the path from negative mood to coping motive was not statistically significant.

At the between-subjects level, the pathway of negative mood to coping motives was statistically significant, as was the relationship between coping motives and LOCE. However, the direct pathway between negative mood and LOCE was not significant. Thus, coping motives fully mediated the relationship between negative mood and LOCE (total indirect effect: $B = 0.216$, $SD = 0.085$, 95% BCI = 0.073 to 0.405). Although there were no significant direct pathways from negative mood to NA reduction expectancies or from NA reduction expectancies to LOCE, the pathway of NA reduction expectancies to coping motives was statistically significant, resulting in a significant indirect association from NA reduction expectancies to LOCE (specific indirect effect: $B = 0.211$, $SD = 0.075$, 95% BCI = 0.089 to 0.380).

3.2.2. Positive mood to LOCE

At the within-subjects level, the pathways from positive mood to pleasure motives and pleasure motives to LOCE were both statistically significant, indicating an indirect effect between positive mood and LOCE. Furthermore, this pathway was moderated by reward

Table 3
Within-subjects indirect effects from mood to LOCE.

Model Parameters	Estimate	SD	95% BCI
Total Indirect Effect			
Negative Mood → LOCE	0.080*	0.032	0.028–0.151
Positive Mood → LOCE	0.023*	0.016	0.001–0.062
Conditional Indirect Effects			
Positive Mood → LOCE at +1SD Reward Expectancy	0.047*	0.028	0.005–0.112
Positive Mood → LOCE at -1SD Reward Expectancy	0.000	0.017	–0.035–0.035

Note: * 95% unrounded Bayesian Credibility Intervals do not include 0.

expectancies, such that the relationship between positive mood and pleasure motives was potentiated at high (+1 *SD*) reward expectancies, $B = 0.301$, $\beta = 0.703$, 95% BCI = 0.111 to 0.497. Notably, the association between positive mood and pleasure motives was no longer statistically significant at low (−1 *SD*) reward expectancies, $B = -0.002$, $\beta = -0.004$, 95% BCI = −0.183 to 0.184. This resulted in a robust indirect association between positive mood and LOCE via pleasure motives when reward expectancies were either high or at their mean, but no association when reward expectancies were below the mean (see Table 2). A regions of significance analysis (see Fig. 1, right callout box) showed that a small shift of 0.29 (0.04 *SD*) below the mean on reward expectancies, effectively diminished the link between positive mood and reward motives at the daily level, subsequently disrupting any indirect association between positive mood and LOCE. Thus, a very small difference in reward expectancies could have robust effects at the daily level on the link between positive mood and LOCE.

At the between-subjects level, pleasure motives did not have a significant direct association with LOCE. Positive mood was also not directly associated with pleasure motives, although reward expectancies were. Therefore, there was no association, direct or indirect, between LOCE and either positive mood or reward expectancies.²

4. Discussion

These findings provide novel insight into the daily-level role of motives driving LOCE behavior. Prior literature has shown a link between negative mood to disinhibited eating (Haedt-Matt & Keel, 2011b; Stevenson et al., 2018). Although eating motives have not been sufficiently assessed to-date at the daily level, cross-sectional data indicates a strong association between coping motives and binge eating (Boggiano et al., 2014; Jackson et al., 2003; Trojanowski et al., 2019). Therefore, it was expected that negative mood would have a strong direct association with LOCE, and a significant indirect association via coping motives. Findings showed that negative mood was directly associated with LOCE at the within-subjects level. That is, on days when participants experienced elevated negative mood, they were more likely to report LOCE. Further, increased intention to use food as a means of coping with one's negative mood state appeared to operate as a mechanism linking negative mood to LOCE risk. Similarly, at the between-subjects level, coping motives fully mediated the relationship between negative mood and LOCE, indicating that individuals who reported greater negative mood during the daily diary period were more likely to report LOCE during the diary protocol, and this relationship was fully explained by greater endorsement of using eating to cope with negative mood. Importantly, NA reduction expectancies did not moderate the path between negative mood and coping motives at the within-person level. This suggests that, among individuals with recurrent LOCE, experiences of negative mood are likely to elicit coping-related motivations to eat, regardless of one's trait-level expectancies that negative mood will be alleviated by LOCE. It is notable, that individuals who do not endorse the belief that eating will help them to effectively manage their emotions, nonetheless seek out food as a coping tool when distressed. One possible explanation for this continued pursuit of food as comfort may be the development of strong habit-based relationships between experiencing negative mood states and engaging in eating, regardless of the anticipated outcome (Schaefer & Steinglass, 2021; Steinglass & Walsh, 2006). Lack of effective alternative coping skills may also contribute to the use of maladaptive (and potentially ineffective) eating behaviors in the face of negative mood (Lavender et al., 2015). Ultimately, these findings suggest that heightened negative mood and the motivation to cope on a given day may be sufficient to drive LOCE for an individual, regardless

of one's general expectation that eating will improve one's mood.

The non-significant direct effect at the between-subjects level between negative mood and LOCE was unanticipated. This may be due, in part, to the daily-level of assessment. The design of the current study does not allow for the sensitivity needed to measure the trajectory of negative mood around LOCE episodes. Prior findings have found that LOCE is associated with increased negative mood pre- (Berg et al., 2013; Schaefer et al., 2020), and in some instances post- (Berg et al., 2015; Stevenson et al., 2018; Wegner et al., 2002), eating episode for many individuals. Therefore, daily averages may not assess this relationship with sufficient specificity. Overall, these findings suggest that when comparing across individuals, the degree to which one is motivated to eat to cope is robustly associated with other predictors that have been found to be associated with LOCE. In addition, when assessing the factors that lead to the presence of LOCE within one individual at the daily-level, higher levels of negative mood and greater motivation to cope with negative mood are associated with LOCE behavior.

The lack of direct and indirect association between positive mood and LOCE at the between-subjects level is consistent with prior cross-sectional findings demonstrating inconsistent, and more often non-significant, associations between positive mood, pleasure motives, and reward expectancies in predicting LOCE pathology (Boggiano et al., 2017; Burgess et al., 2014; Burr, 2021; Hayaki & Free, 2016; Hohlstein et al., 1998). This finding indicates that individuals who experienced greater levels of positive affect in the EMA protocol did not necessarily engage in higher (or lower) levels of LOCE during the protocol. However, at the within-subjects level, positive mood was significantly indirectly associated with LOCE. These findings suggest that on days when individuals with recurrent LOCE experience greater positive mood, they may be at greater risk for engaging in LOCE, due to increased motivations to eat for enjoyment. Notably, this relationship may only appear under very specific parameters. That is, the within-person path between positive mood and pleasure motives was moderated such that the relationship was only present at mean-to-high levels of trait reward expectancies, but was eliminated at low levels of reward expectancy. This means that in order for experiences of positive mood to translate into eating for enjoyment, one must generally endorse the expectancy that food is rewarding at moderate to high levels. In contrast, this relationship is rapidly attenuated to the degree that it is no longer statistically significant among individuals who generally endorse low levels of reward-related eating expectancies (see Fig. 1). These findings suggest that positive mood may precipitate LOCE, but only in the presence of other vulnerabilities, particularly enduring beliefs that eating will lead to a sense of reward and a momentary motivation to eat for pleasure.

Overall, the most consistent predictor of LOCE appears to be negative mood, or factors related to alleviation of negative mood, such as motives to eat to cope. However, positive mood within this model was associated with LOCE for individuals with very particular parameters (i.e., those who have higher overall reward expectancies salient to food who are experiencing motives to eat for pleasure). Although prior cross-sectional studies have largely not supported positive emotions leading to LOCE pathology, research does support associations between positive mood and other maladaptive behaviors. For example, EMA research in alcohol consumption has found that positive emotions often predict subsequent adverse alcohol outcomes (use and problems), and indicates that these associations are mediated by mood enhancement motives (Dvorak et al., 2014; Stevenson et al., 2019). Interestingly, this effect is most pronounced at the within-subject (i.e., momentary or daily) level. This pattern (along with the pattern of results observed in the current study) suggests that although maladaptive behaviors such as LOCE and problematic substance use may not be more (or less) likely to occur among individuals who report higher levels of positive mood (relative to others), during the times when those individuals experience elevated positive mood (relative to their own average) they are at increased risk for engaging in problematic behaviors – perhaps based on a desire to maintain those positive emotions.

² This model was also run not accounting for age, sex, BMI, and EDEQ scores with very similar results in terms of significance and total effects. Results for the model that does not control for covariates or general eating pathology may be found here: <https://osf.io/da79z/>.

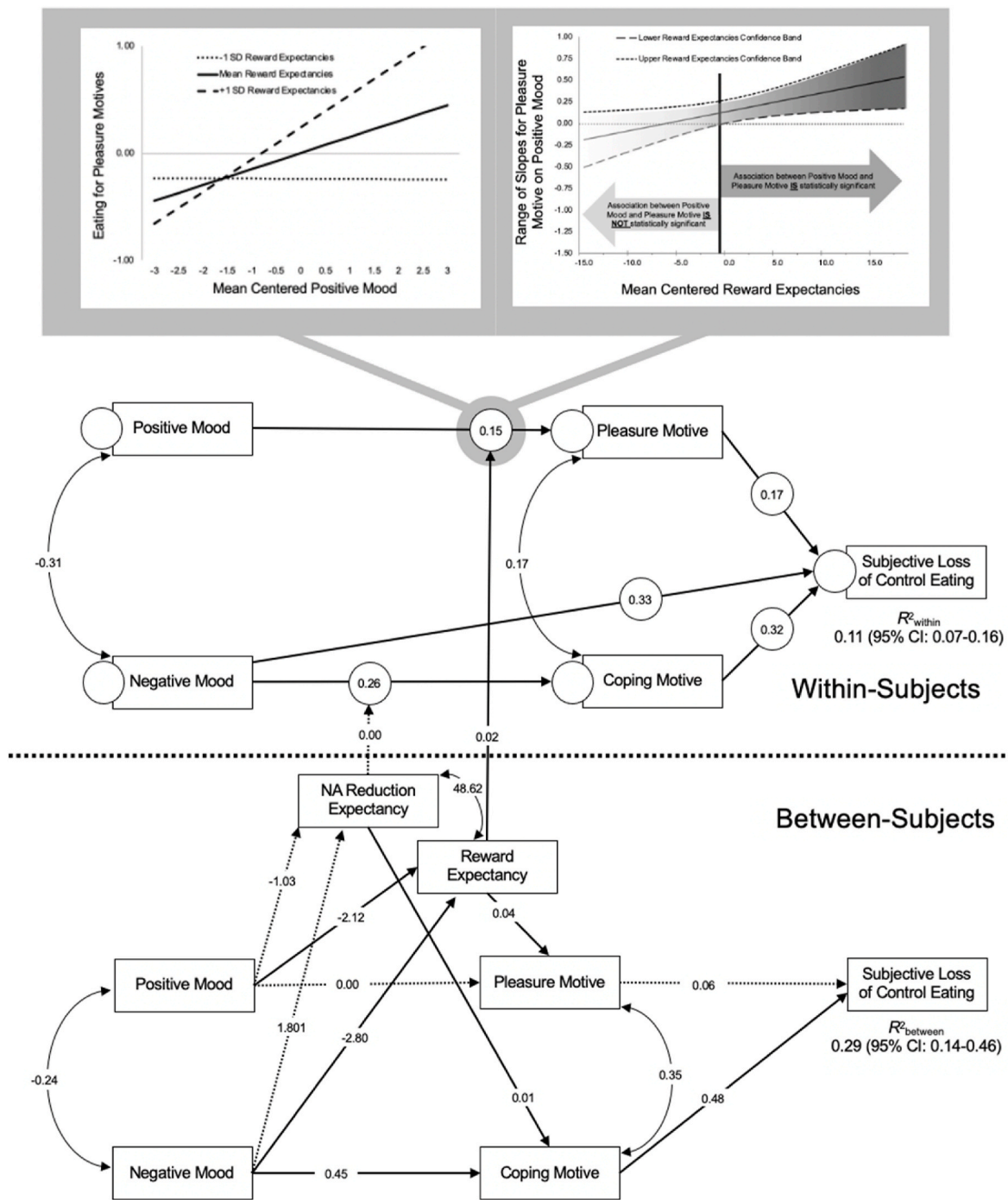


Fig. 1. Multilevel structural equation model of mood to loss of control eating.

As this is the first study to examine these paths across levels of analysis, these associations require replication. Nonetheless, these results add to a growing body of evidence indicating a transdiagnostic model whereby positive mood increases hedonic drive for positively reinforcing behaviors at the day/moment level and negative mood produces a pattern of negative reinforcement motivation, which manifests as a more stable (within- and between-subjects) behavioral pattern that leads to a greater likelihood of pathology more broadly.

While the current results vary slightly from the results in the substance use literature (i.e., coping motives appear relevant at both within- and between-levels for eating, though not for alcohol use, see Cook et al., 2020; Dvorak et al., 2014; Stevenson et al., 2019), there are also some important convergent effects. It appears that positive mood may

increase motivation for behaviors that increase the likelihood of more positive mood in the moment, and this is especially true among those that believe food is highly rewarding. At the between-subject level, this hedonic drive does not translate to more maladaptive behavior, perhaps because higher positive mood, globally, tends to confer broad protective effects (Moskowitz, 2011).

In contrast, individuals with more negative mood, and stronger NA reduction motivation, broadly engage in more pathological/maladaptive behaviors (Swerdlow et al., 2020). We see this occurring at the day level, which results in stronger motivation to dampen negative mood via maladaptive behaviors (i.e., LOCE) at any given moment or on any given day. While this may not always result in day/moment levels of maladaptive behavior (at least in substance use literature, though it does

appear to in LOCE), it does appear to result in a pattern of repeated maladaptive coping and subsequent adverse outcomes. Thus, individuals who engage in this pattern of behavior more often, may place themselves at a greater risk for more pathological behaviors (e.g., substance use, LOCE, etc.).

However, in eating research, positive mood is less often predictive of LOCE, relative to negative mood (Stevenson et al., 2018), although it is worth noting that the majority of prior research is cross-sectional, and therefore only assesses these factors at the between-subjects level.

4.1. Limitations

This study is not without its limitations. First, data on gender identity and sexual orientation was not collected. Additionally, while the racial demographics of the sample over-represented racial minorities in comparison to U.S. Census data (United States Census Bureau, 2019), participants were predominately white (67.90%) and female (75.23%) and over-represented non-Hispanics (88.99%). Therefore, this sample does not represent racial minority groups sufficiently to make cross-race comparisons and it cannot be concluded that results are generalizable to all adults. Future research should aim to use stratified random sampling for a more diverse sample to make those comparisons.

Second, while the use of a daily diary design may provide more accurate and nuanced data than less frequent retrospective recall; daily recall may still exhibit self-report bias (Gunthert & Wenze, 2012). The study was not a true EMA design and did not assess variables at the exact time of their occurrence. Similarly, this study did not assess expectancies at the same time point as motives. Although there is scant prior research incorporating eating expectancies into an EMA design (Pearson et al., 2018), it is possible that the single item used in these studies may have tapped mood-driven eating motives, which were not separately assessed in those designs. Therefore, although the current study presents a design with sound theoretical backing, it may be beneficial for future research to use *in situ* momentary assessments to help control for retrospective recall bias and to help differentiate momentary/daily expectancies and motives for respondents to ascertain the relative temporal nature and stability of each. Still, this study is an important step towards answering research questions regarding the nature of motives and expectancies in LOCE. Third, data was collected in Fall of 2020, during the COVID-19 pandemic. While some research suggests many individuals may have returned to pre-pandemic levels of psychological distress by the point of data collection (Daly & Robinson, 2021), those presenting with LOCE pathology as exhibited in disordered eating, as well as the related vulnerabilities of depressive symptoms, may have retained heightened pathological behavior without attenuation (Giel et al., 2021). Given that this sample had to endorse LOCE presence for eligibility criteria, it is possible they may be reporting heightened pathology due to the time of data collection.

Lastly, because the current study is novel, there is a dearth of prior research to contextualize results. Therefore, interpretation of the results must be viewed as exploratory hypotheses. Future research should seek to validate the present findings, particularly with more nuanced EMA assessment methods.

4.2. Clinical implications

These results emphasize the importance of mood, eating motives, and expectancies in LOCE, providing promising implications for eating intervention research. Findings indicate that negative mood is robustly linked to LOCE via coping motives, as is NA reduction expectancies between-subjects. Thus, eating interventions that specifically target relevant mechanisms to adaptive reduction of negative mood such (e.g., emotion regulation difficulties, Kukkk & Akkermann, 2017), as well as eating motives and expectancies could be useful for individuals engaging in LOCE. One approach is dialectical behavior therapy (DBT), which has been adapted to treat LOCE pathology by bolstering emotion

regulation ability (Klein et al., 2013). DBT-based adaptations for binge eating have produced significant improvements in eating behavior (Berg & Wonderlich, 2013; Klein et al., 2013; Safer & Jo, 2010) as well as reductions in LOCE and emotional eating (Fischer & Peterson 2015; Souza et al., 2019). However, it is important to keep in mind that many DBT-based eating interventions are time-consuming and are not designed to account for the roles of expectancies and momentary motives. Thus, there is a need for brief interventions that can target NA reduction expectancies and eating to cope motives. Although there are no interventions targeting eating expectancies to-date, preliminary research suggests that when negative mood is believed to be unchangeable, individuals exhibit less coping-motivated eating and consume less food after a distress induction, in comparison to those who do not have such an expectancy (Tice et al., 2001). Therefore, brief interventions that introduce alternative expectancies may be useful in reducing individual's eating to cope motives and may be effective supplements to current interventions targeting LOCE pathology. It is also of note that on a daily level, positive mood is predictive of LOCE under specific circumstances (presence of heightened reward expectancies and pleasure motives). Therefore, it may be useful for clinicians working with individuals reporting habitual LOCE to assess and monitor eating expectancies and motives, as well as both positive and negative mood lability.

4.3. Conclusion

The present study provides novel insight into psychological factors that may influence the association between daily-level mood and LOCE. Findings showcase that between individuals, the strength of daily coping motives enhances other predictors associated with LOCE (e.g., negative mood, NA reduction expectancies). Heightened negative mood as well as greater motivation to cope are strongly associated with LOCE behavior. Additionally, momentary positive mood was associated with LOCE within-subjects when individuals hold both average to high overall reward expectancies and pleasure motives had current salience. These findings suggest that greater negative mood and coping motives overall are associated with whether a day is characterized by LOCE without significant influence of one's level of expectancies eating reduces negative affect on that pathway. However, reward expectancies are salient for individuals whom have higher levels of these expectancies, in that they increase the strength of the association between daily level positive mood and motives to eat for pleasure, increasing likelihood of LOCE that day. Future research should continue to investigate the impact of heightened affective states on motives, expectancies, and LOCE behavior at the daily-level as well as longitudinally. Overall, this study serves as a potential springboard for future LOCE research and interventions.

Author contributions

EKB and RDD developed the study design and conducted the data analyses. EKB additionally oversaw the data collection and drafted the majority of the paper, as well as completing revisions for submission under the supervision of RDD. AND and AVL drafted the clinical implications and limitations, respectively. RP drafted a paragraph for the results. LMS and SAW provided feedback and critical revisions. The final version of this paper has been approved by the authors for submission.

Ethical statement

This study was approved by the institutional review board (IRB) at the University of Central Florida, from which it was hosted and conducted within compliance of APA research standards. Participants provided informed consent prior to completing each phase of the study.

Declaration of competing interest

All authors have no competing interests or conflict of interest to declare.

Data availability

Data will be made available on request.

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